# Climate VISION Risk Framework for Advanced Clean Coal Plants

## *Risks & Challenges*

**Presentation to Roundtable on Deploying Advanced Clean Coal Plants**
**July 29, 2004, Washington, DC**

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# *Clean Coal: Leading Questions*

- Market factors and business risks have shifted since 2000 to favor consideration of clean coal (e.g., sharp spikes and volatility in natural gas prices).
- Yet, few IGCC plants being ordered. Is it primarily a matter of elevated capital costs? Other business risks?
- Which risks most deter construction of commercial clean coal plants?
- What policies might best encourage commercial adoption of "clean coal gasification" (e.g., environmental regulations, state & federal financial support)?
- If they are needed, how could incentives be targeted on critical risks to improve the prospects for advanced clean coal plants?

# *Why Are So Few IGCCs on Order?*

**Excerpts from interviews**

**DOE:** We are looking to buy down the cost of the plant by 40% to 50%, so why are so few utilities considering IGCC ?

**Utility:** Even if DOE puts up $500M on a $1 billion plant, we still have $500M at risk if the gasifier fails to perform. We are in the power business where reliability is king; we don't want to be 'guinea pigs'; let someone else try first.

**PUC Commissioner:** What does this gasification system cost per KW, and who is standing behind the performance guarantee?

**Utility:** A gasifier looks (and smells) like a chemical plant; we are not in the chemical business.

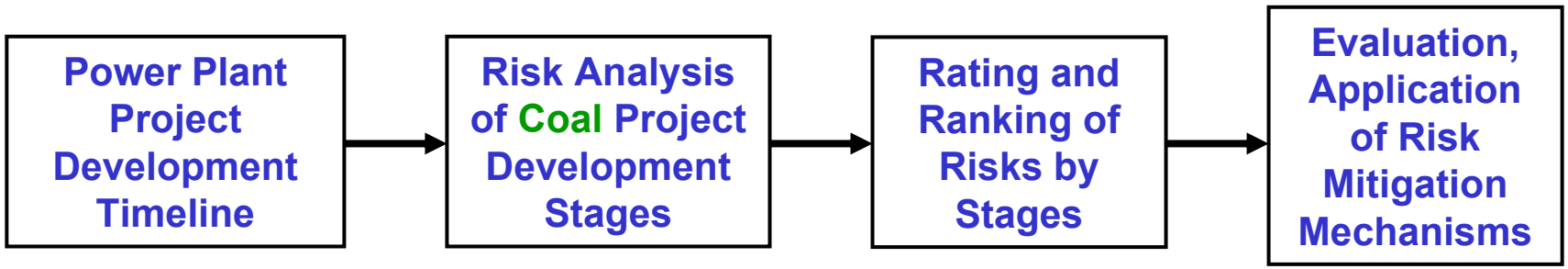
**Technology vendor:** We are just making a component of the total plant, we do not want to be liable for delivering power – our units make fuels and by-products.

**Lab:** Our research shows that IGCC may <u>not</u> be the best choice for low-rank coals (sub-bituminous, lignite – with higher moisture).

**?**

# Risk Framework Methodology

## Diagram depicts logic flow and approach to DOE's analysis.




Timeline Evaluation

- Delineation of key development stages for power plant
- Matching of development stages with financing events

The risk framework approach builds on work done for the "Business Case for Nuclear Power" (www.nuclear.gov)

Risk Analysis by Stage of Project Development

**"Showstoppers":**

- Air regulatory issues?
- Tech performance and availability?
- PUC rate approval?

**Major Risk Category**

- Technology / Design
- Development / Siting
- Regulatory
- Construction
- Operating performance
- Fuel price, supply
- Demand
- Dispatch
- Waste, byproducts
- Transmission

Interview and Rating Approach

- Design of survey instrument
- Work with industry groups for interview candidates
- Selection of interview candidates
- Contact of candidates
- Interviews, risk ratings
- Evaluation of risks
- Workshops with industry on results

Evaluation of Mitigation Mechanisms

- Financial model and sensitivity analysis (conducted by utilities)
- Delineation of mechanisms
- Matching of possible mechanisms to risks
- Evaluation of risk coverage for each stage
- Determination of measures, legislation needed to implement
- Negotiations

# *Risk Framework Built to Project Timeline*

## What it's not:

- **Not a *technical* framework, e.g., an RD&D roadmap.**
- **Not a *regulatory* framework.**
- **Not biased toward any specific fuel source.**
- **Not based solely on economic analysis.**
- **Not another "barriers" study.**

## What it is:

- **Based on analysis of "business risks" from project development and plant owner perspective.**

# *Categories of Business Risk*

- **Business risks for advanced clean coal plants fall into three categories:**

  **Technical**

  **Regulatory**

  **Market**

# *Input from Several Viewpoints*

**Utilities, IPPs**

AEP
Cinergy
EPRI
Excelsior Energy
Global Energy
Southern Co.
Tampa Electric
WE Energy
Tennessee Valley Authority
Tri-State Generation

**Engineering Firms & Energy Cos.**

Alstom
Bechtel
Burns & McDonnell
Conoco Energy
CONSOL
Eastman Chemical
Fluor Engineering
Foster Wheeler USA
Kennecott Energy

**Technology Firms, Labs, DOE**

Air Products & Chemicals
ChevronTexaco Gasification
Gas Technology Institute
Gasification Technology Council
Powerspan
Siemens
TMS
DOE & NETL

**Financial Community**

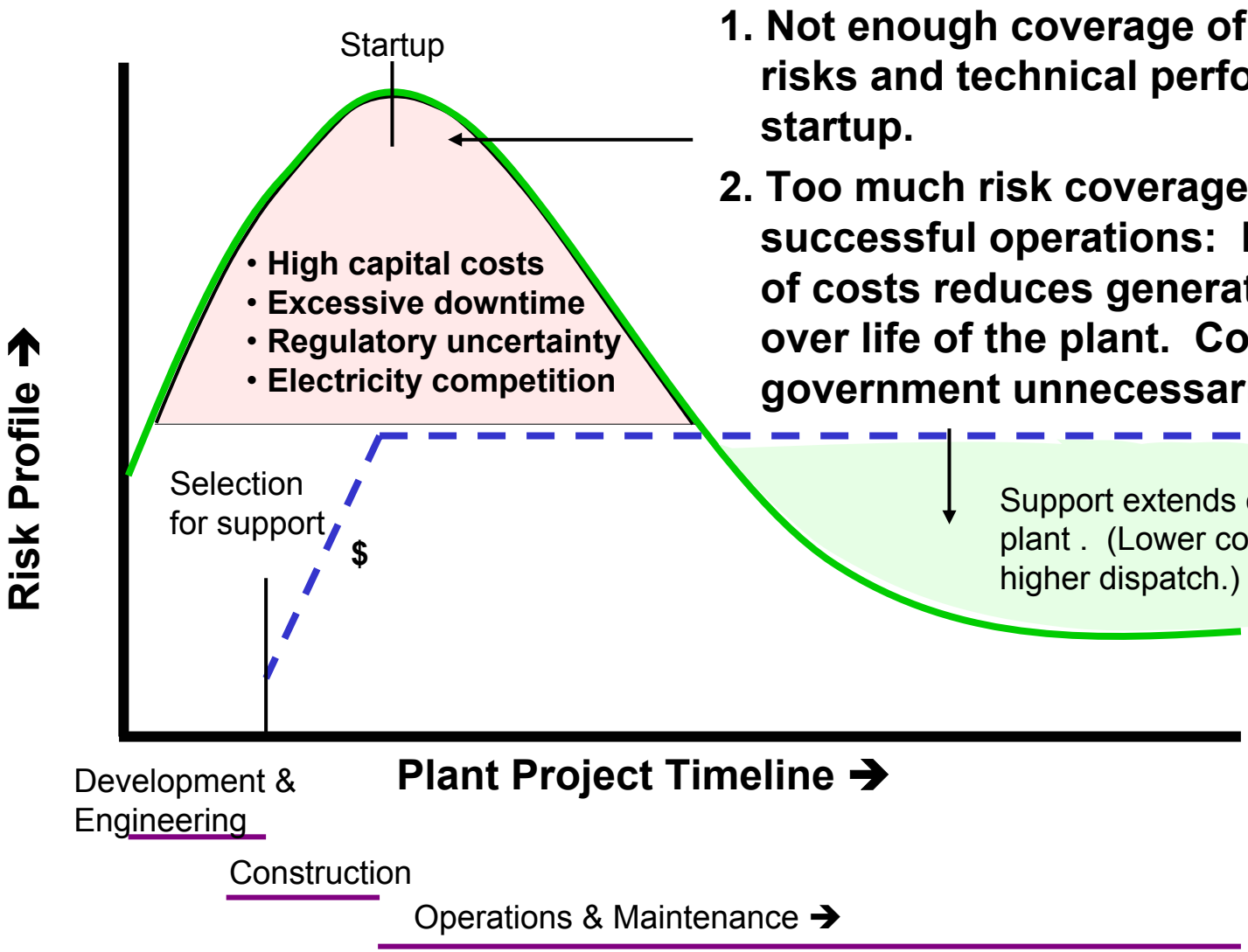
CS First Boston
JP Morgan Chase
EBI
Rosenberg & Associates

# *Risk Rating Recap: Highest Risks*

**Clean coal systems offer public benefits, but are not fully proven. High capital costs magnify risks. State and national policies not yet clear. Financing large plants poses challenges… Risk-informed credit-based assistance can help address them effectively and efficiently.**

| | Risk Area for IGCC<br>**Highest Risks** | A<br>Probable | B<br>Severity | A x B<br>Rating-1 |
|---|---|---|---|---|
| Technical | 1 High capital cost | 4.4 | 4.7 | **20.4** |
| Technical | 3 Excessive downtime | 3.7 | 4.4 | **16.5** |
| Technical | 5 Lack of standardization | 3.7 | 3.5 | **12.9** |
| Regulatory | 18 No state policies for IGCC | 3.3 | 3.7 | **12.1** |
| Regulatory | 19 Nat'l policy on IGCC lags | 3.4 | 4.2 | **14.4** |
| Market | 26 PUC rate approval fails | 2.9 | 4.6 | **13.2** |
| Market | 27 Financing difficult | 3.7 | 4.5 | **16.5** |

# *Risk Profile: Too High Early in Plant Life*




1. **Not enough coverage of operating risks and technical performance at startup.**
2. **Too much risk coverage after successful operations: Buydown of costs reduces generation cost over life of the plant. Cost to government unnecessarily high.**

# *IGCC Risk Traits – 1,2,3: Observations*

- Industry rates technology risks as too high without government support.
- Top concerns: High capital cost and excessive downtime, which make financing difficult. Warranties appear to be inadequate.
- Risk of decline in gas prices rates as a low probability, but would be a high severity event. Gas price rises make clean coal plantsmore competitive.
- Owners remain skeptical that full valuation of $CO_2$ advantages will materialize in near term. IGCCs may have an edge on capture of mercury.

# *IGCC Risk Traits – 1,2,3: Observations*

(continued)

- State policy can help, but probably will be insufficient in most states. PUC rate approval would be a useful risk mitigator.
- Electricity competition is a concern due, in part, to uncertainties about regional impacts of market reforms.
- If federal government accepts significant technology risk, then adequate EPC warranties probably could be negotiated. Government backing should reduce contingency in price of plants.
- Workforce issues (for construction and operation) rate low.

# *Implications for Potential Federal Role*

Base any potential federal roles on several principles:

- Risk sharing across the value chain.
- Market leadership.
- Targeting incentives to provide greatest value towards management of critical risks.
- Mobilization of private investment.
- Maximized federal leverage.
- Keep federal cost low, while generating high impact.

# *Reference Slides*

# *IGCC Risk Study – 1: Questions*

**REFERENCE**

Risks are evaluated based on “probability of occurrence” and “severity of impact”, if risk is realized.

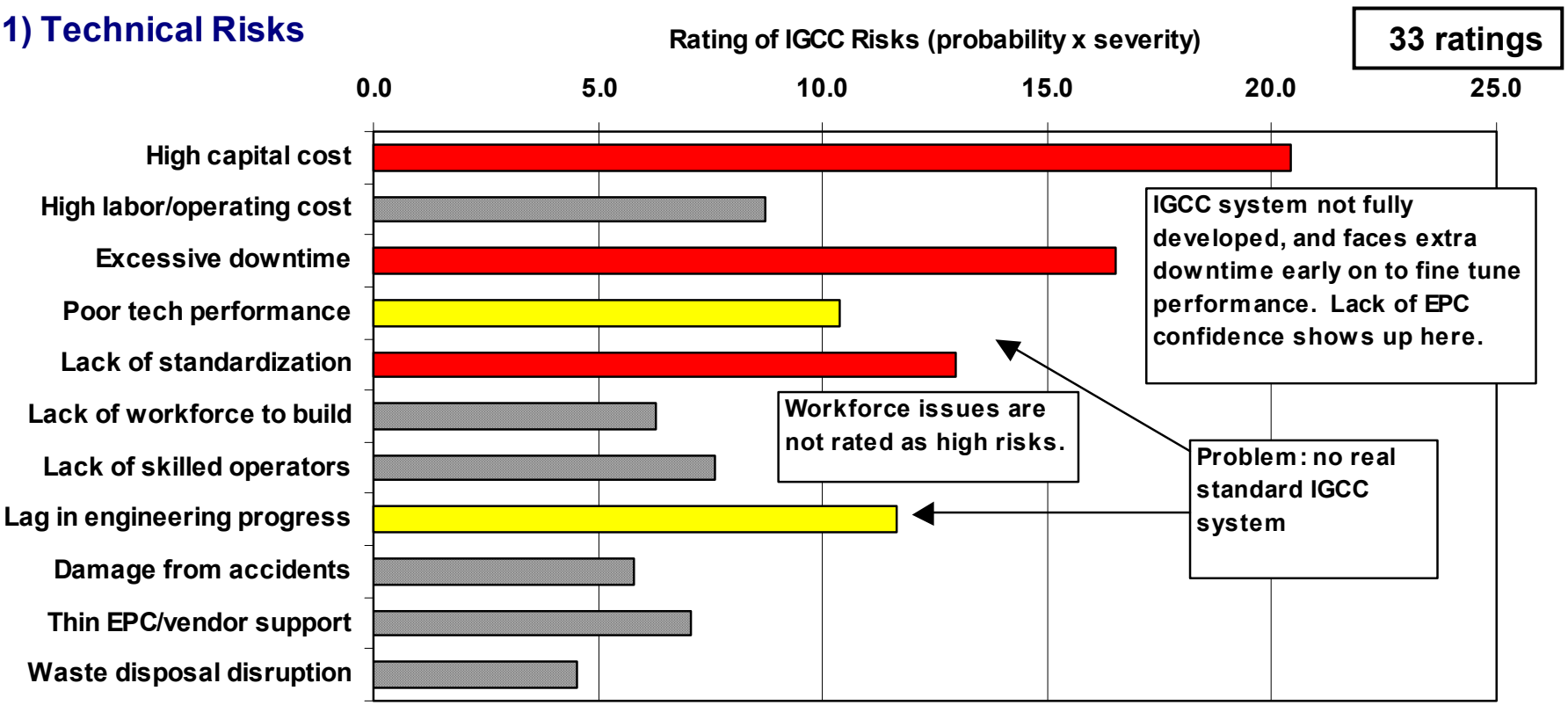
**TECHNOLOGY & OPERATIONS RISKS** (system performance)

- Risk: Electric price is materially higher for IGCC due to high capital costs.
- Lack of competitiveness of electricity due to higher labor or operating costs.
- Excessive IGCC breakdown, downtime, non-routine engineering & repair costs.
- Poor technical performance of IGCC relative to specs (e.g., higher heat rate).
- Lack of standardized IGCC systems (higher costs or reduced performance).
- Lack of skilled workforce to build IGCC plants to specifications.
- Lack of skilled operators to properly run IGCC plants to specifications.
- Lack of materials and engineering progress keep system costs high (>$1,500/KWe).
- Acute accidents generate penalties or severely damage the plant.
- EPC or vendor fails to provide adequate support of IGCC to maintain performance after startup.
- Waste disposal risk (e.g., price of disposal rises sharply or location is closed).

# IGCC Risk Ratings – 1: Technical

REFERENCE

## 1) Technical Risks



# *IGCC Risk Study – 2: Questions*

**REFERENCE**

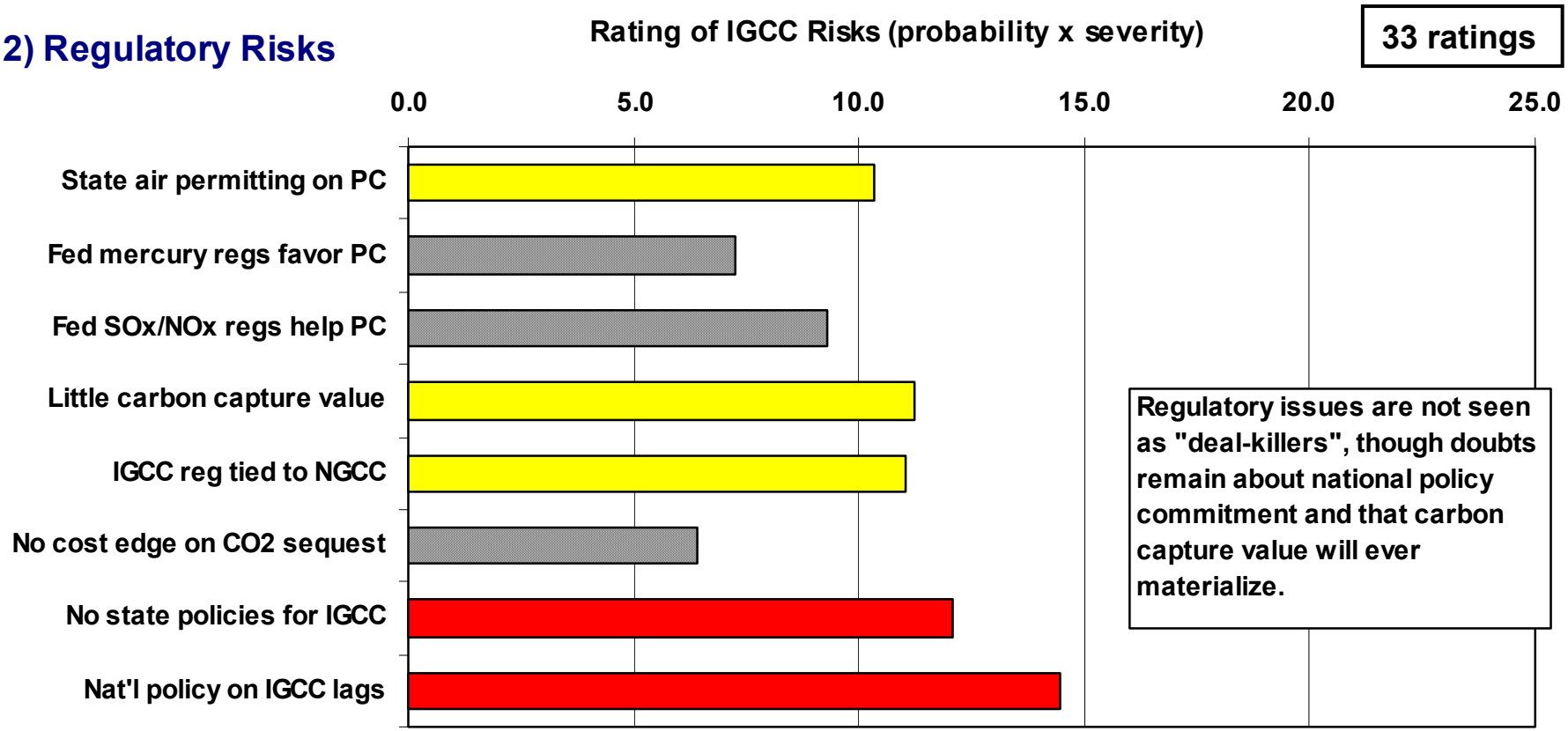
**REGULATORY & POLICY RISKS** (differentiation for IGCC)

- Risk: State-level air permitting delays fail to deter conventional coal plant orders.
- Federal mercury regulations favor conventional coal (e.g., PC) plants.
- Federal SOx and NOx regulatory delays favor conventional coal plants.
- Economic value of carbon capture fails to materialize, reducing advantage of IGCC.
- Risk that IGCC is regulated (by states or EPA) based on NGCC performance.
- Cost of carbon sequestration for PC plants approximates that for IGCC.
- Regional and state policies fail to provide any or sufficient incentives for IGCC
- National policies provide insufficient rewards, incentives for IGCC (e.g., tax, NSR, etc.).

# IGCC Risk Ratings – 2: Regulatory

REFERENCE

## 2) Regulatory Risks



# *IGCC Risk Study – 3: Questions*

REFERENCE

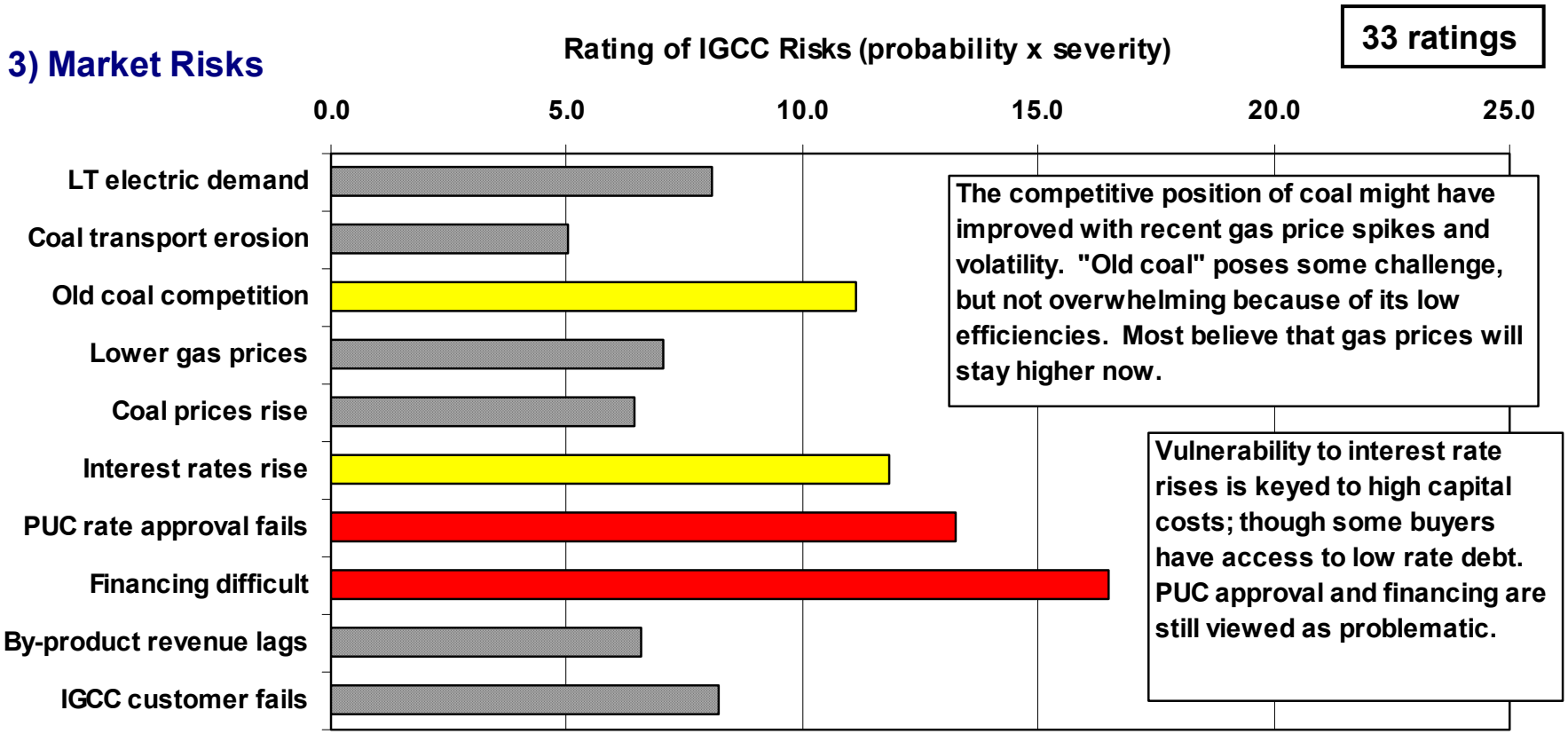
**MARKET & FINANCE RISKS** (dynamics of demand and supply)

- Long-term electricity demand (for utilities, IPPs) fails to grow as fast as forecast.
- Erosion of coal transportation infrastructure raises delivered cost of coal over time.
- Competing “old coal” generation reduces dispatch of IGCC, thereby curbing revenues.
- Low natural gas prices make NGCC more competitive (reducing dispatch).
- Coal prices rise markedly, inflating IGCC electricity generation costs.
- Interest rates rise in the medium term, penalizing new capital-intensive projects.
- State PUC does not approve long-term contract or rate review to cover IGCC costs.
- Financing of IGCC is difficult, or requires lots of equity, even at low interest rates.
- Revenues of IGCC by-products (e.g., sulfur, slag) fail to materialize as forecast.
- Customer of IGCC suffers significant losses and cancels IGCC project midway.

# IGCC Risk Ratings – 3: Market

REFERENCE

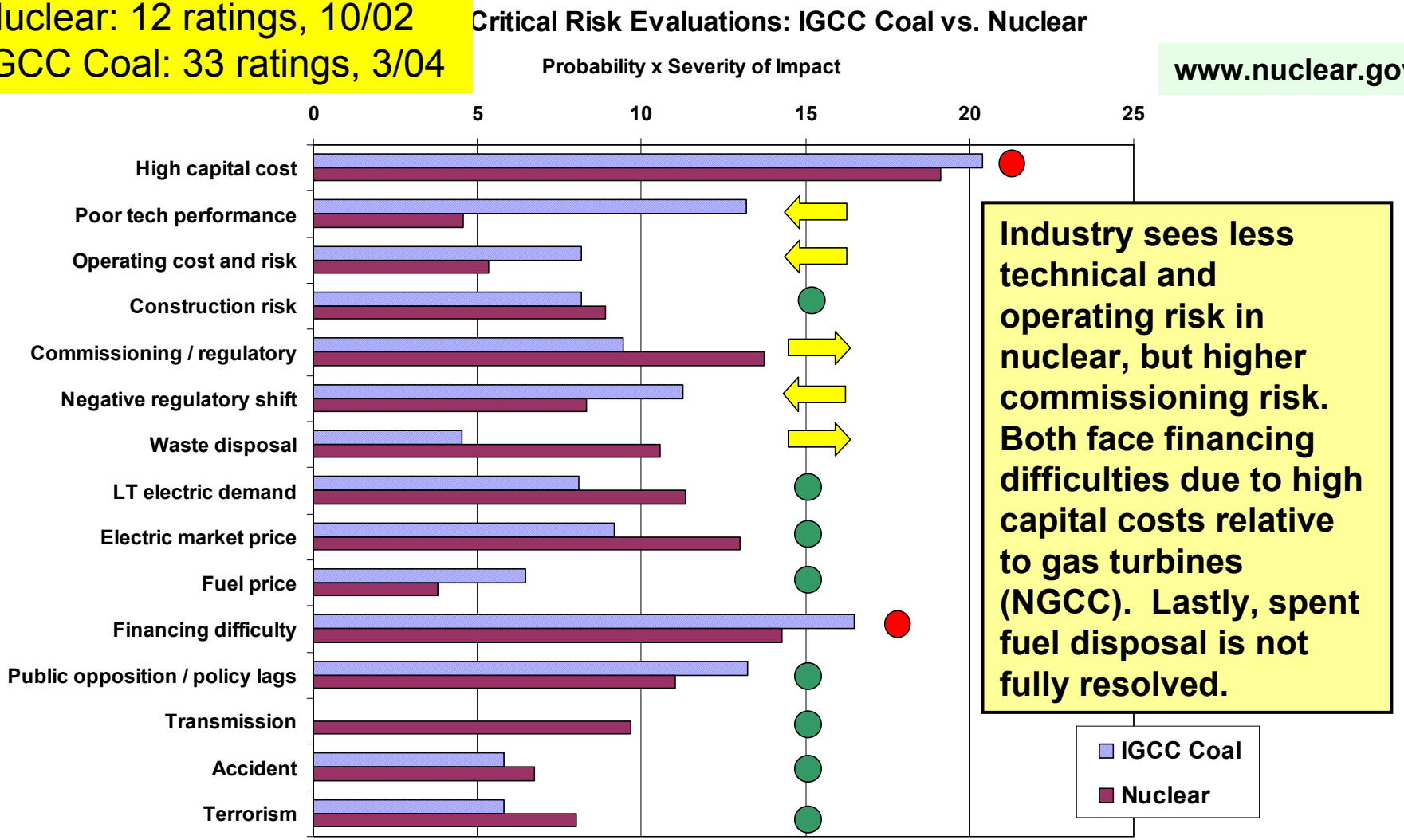
## 3) Market Risks



# *Risk Comparison: IGCC v. Nuclear*

REFERENCE

Nuclear: 12 ratings, 10/02
IGCC Coal: 33 ratings, 3/04




www.nuclear.gov

**Industry sees less technical and operating risk in nuclear, but higher commissioning risk. Both face financing difficulties due to high capital costs relative to gas turbines (NGCC). Lastly, spent fuel disposal is not fully resolved.**

# *Why Coal Gasification ?*

**REFERENCE**

### What is IGCC ?

- Gasifier (fuel) ➔ gas turbine
  + steam turbine to spin generators

The big difference: IGCC uses a gasifier to create fuel plus better environmental control features.

**Conventional power plant:**

Boiler + steam turbine spins generators

**Simple cycle gas plant:**

Gas turbine spins generators

**Combined cycle gas plant:**

Gas turbine + HRSB ➔ steam turbine spins generators

(HRSB: heat recovery steam boiler captures heat coming out of gas turbine to generate steam for the steam turbine)

### Potential Advantages of IGCC

- Higher thermal efficiency ~50% v. 40%
- Removes sulfur, Hg, and other contaminants before combustion, eliminating scrubbers
- Accepts wider range of feedstocks and feedstock quality
- Easier to capture by-products for sale
- Less input water needed: Post-combustion flue gas desulfurization not needed to reduce SOx emissions – in contrast to conventional coal boilers
- Smaller discharge of cooling water (~30%) than conventional coal
- Note: Most gasifiers in operation today are used for processing refinery wastes and making chemicals (ammonia, syngas, methanol)

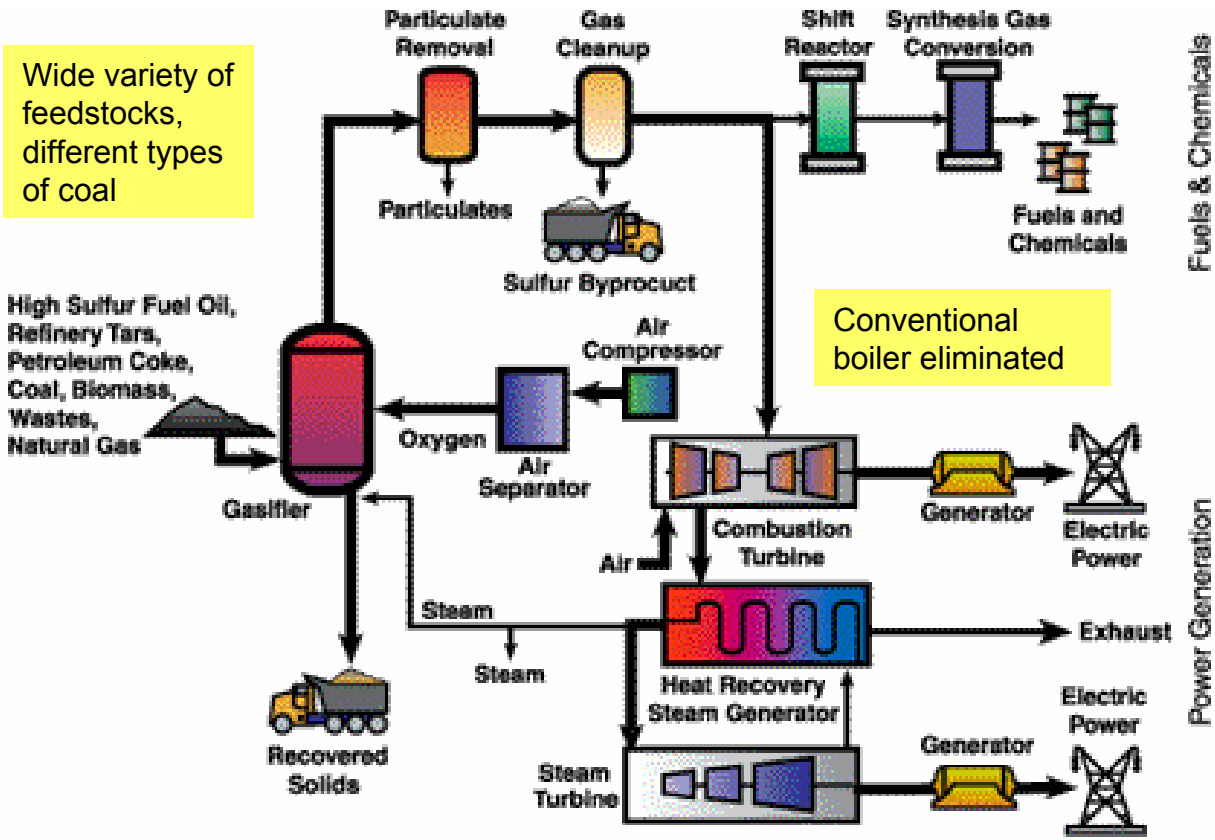
# Gasification with Combined Cycle

**REFERENCE**

CO2 capture can be added more easily

Gasfiers create opportunities to fabricate a wider array of products, and byproducts (sulfur, slag).

Wide variety of feedstocks, different types of coal




Fuel cells can also be installed later to produce more electricity from syngas (H2)

Source: CURC

# www.ClimateVISION.gov